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Sounds and symbols : the relationship between auditory processing and reading

Jacqueline Kohos
Bank Street College of Education

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The Relationship Between Auditory Processing and Reading

By

Jacqueline Kohos

Childhood General and Special Education

Mentor:

Ellie Costa

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ABSTRACT

This project explores the relationship between auditory processing and reading. Inspired by the students and teachers of my first year teaching, this work analyzes five areas of reading challenge through the lens of auditory processing: letter names and sounds, phonological awareness, sight words, decoding and fluency. These challenges are described in detail with examples that connect to the learning profiles of several students I have taught. This work identifies the auditory processing skills needed to support these five areas of reading, and offers resources, many of which I have implemented with my students, that teachers can use to help children with auditory weaknesses build these skills.

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INTRODUCTION

This project was inspired by the events, children and teachers from my first year teaching. I began that first year in a new charter school as an associate special education teacher. Mid-year, I moved from the classroom to serve as a Special Education Teacher Support Services (SETSS) provider to support the growing number of children with special needs who were enrolling in my school. The beauty of my school is that we never turn a child away. No matter the child's need, we find a way to support him or her even if we have to create that way. My first year, the challenge with this philosophy was that though I tried to figure it out as I went, I had little idea how to best support my students.

Though I taught reading, writing and math, it was reading that left me with the most questions. I saw that my students, first graders and kindergarteners with myriad disabilities including speech and language impairments, learning disabilities, Autism and ADHD, presented with similar challenges in learning to read. I needed to understand why some children acquired the building blocks to reading (letter names and sounds, segmenting and blending) with ease, and many of my students struggled. While some children knew that the word cat has three sounds, that watermelon has four syllables, and could understand that hop and pop rhyme, many of my students could not.

Perhaps my greatest concern was those students who struggled to decode. Why was it so easy for me to know that the sounds c/a/t blend together to make the word cat, and so difficult for some of my students to perceive that? I knew these students had heard the sounds clearly, but where in processing these sounds had the breakdown

occurred? These questions inspired my exploration into the world of auditory processing.

At the heart of this work are my students and their teachers who I also support. I entered into this project hoping to understand the challenges my students were facing, gain insight into the way they learned and be able to transfer this information to their teachers who were equally perplexed and seeking tools to help. This project will answer the following questions:

- What is auditory processing?
- How does auditory processing relate to reading acquisition?
- How do auditory processing deficits affect reading acquisition?
- How can teachers help students who are experiencing these difficulties?

WHAT IS AUDITORY PROCESSING?

When I began this work, I grappled with the term auditory processing and terms related to it. I knew many of my students were struggling with auditory information, but I wanted to understand what auditory processing meant and whether this term related to the challenges I was seeing my students experience. I also needed to differentiate between Central Auditory Processing Disorder (CAPD), a specific deficit in the auditory nervous system, and the auditory processing challenges I saw in my students. Could children have weak auditory processing skills without having auditory processing disorder? This was a central question I sought to answer to better understand my students. Furthermore, I wanted to know whether these auditory weaknesses were more common in children with certain disabilities. Was the root of the challenges my children with SLI, Autism, and learning disabilities experiencing the same or did they just appear that way? The definition of auditory processing and its related terms will be explored in this next section.

Auditory processing can be described simply as "what the brain does with what the ear hears" (Florida Department of Education, 2001, p. 2). Children with auditory processing weaknesses have intact hearing, but have difficulty making sense of auditory information. According to Riggs (n.d.), director at the National Association for Child Development's (NACD) Center for Speech and Sound, auditory processing is composed of the sub-skills: auditory attention, auditory discrimination, auditory sequential processing, auditory tonal processing, auditory memory, auditory sensitivity, auditory

figure-ground processing, language processing and temporal processing. These terms are defined in detail:

- Auditory attention—being able to "tune in" to auditory input.
- Auditory discrimination—the ability to distinguish between different sounds or words.
- Auditory sequential processing—how many pieces of information one can listen to (receive), store, recall, and utilize. Related to auditory memory. Often tested in terms of digit spans.
- Auditory tonal processing—the correct processing of sounds or tones; related somewhat to auditory discrimination, but takes it a step further; has a significant impact on language processing.
- Auditory memory—ability to store and recall auditory information.
- Auditory sensitivity—perception of sound loudness; hyposensitive individuals have a reduced response to sound in their environment, even when hearing is "normal." Hypersensitive individuals over-respond to "normal" sounds, often perceiving typical environmental sounds as bothersome or too loud.
- Auditory figure-ground processing—ability to attend to and process an auditory stimulus in the presence of background sound.
- Temporal processing—related to the "time" aspect of the auditory signal; rate of processing.

- Language processing—processing the meaning of verbal input. This is not true auditory processing. It is the next step after auditory processing occurs.

(Riggs, n.d., para. 4)

- Auditory analysis is the ability to identify phonemes or morphemes embedded in words. This skill is important for distinguishing verb tenses (e.g., worked vs. works) and other morphological markers that may be acoustically distorted or masked by background noise.

- Auditory synthesis is the ability to synthesize (i.e., merge or blend) isolated phonemes into words. Auditory synthesis is critical to the reading process.

- Auditory association is the attachment of meaning. It requires the listener to identify an acoustic signal and associate it with its source or to label a linguistic or non-linguistic sound or experience. Auditory association is a fundamental skill for developing auditory memory.

(Florida Department of Education, 2001, p. 3)

- Central Auditory Processing Disorder:

According to the American Speech-Language-Hearing Association (2005) CAPD is a deficit in the auditory nervous system that makes processing auditory input difficult. CAPD must be diagnosed by an audiologist through a process of testing that

indicates that the person's disability is primarily in the auditory modality and that it is not the result of any other impairment such as Autism or ADHD.

While these aspects of auditory processing are important for understanding the possible roots of the challenges my students were facing, they seemed out of the scope of my practice. In fact, deficits in any of the areas listed above are generally remediated by speech and language pathologists and/or audiologists (American Speech-Language-Hearing Association, 2005). I knew I would have to dig deeper to determine the overlap between auditory processing deficits and the work I do with my students in order to determine how best to support them.

WHO MIGHT EXPERIENCE AUDITORY PROCESSING WEAKNESSES?

While children with Auditory Processing Disorder can be expected to have weak auditory processing skills, children with Down Syndrome, Autism, Dyslexia and Speech and Language Impairments may be likely to present with these challenges as well (Silverstein, 2015). For example, research suggests that children with Down Syndrome have weak auditory working memory skills, which in combination with other processing weaknesses impact their ability to learn to read (Conners, Rosenquist & Taylor, 2001; Broadley, MacDonald & Buckley, 1995). Furthermore, the Autism Research Institute (n.d.) notes the presence of auditory processing weaknesses in children with Autism Spectrum Disorders (ASD) as well. This weakness is believed to be a result of an underdeveloped hippocampus (where auditory information is sent to be analyzed after being processed by the Auditory Cortex), common in ASD (Bauman & Kemper, 1994 as cited in Autism Research Institute, n.d.).

Auditory processing weaknesses have also been studied in children diagnosed with Dyslexia and Language Impairment (LI) (Sharma, Purdy & Kelly, 2009; Benasich, Thomas, & Leppanen, 2002; McArthur & Bishop, 2004a, 2004b; Tallal & Stark, 1981; Wible, Nicol, & Kraus, 2005; Ahissar, Protopapas, Reid, & Merzenich, 2000; Amitay, Ahissar, & Nelken, 2002; Heiervang, Stevenson, & Hugdahl, 2002; Rosen & Manganari, 2001; Sharma, Purdy, Newall, Wheldall, Beaman & Dillon, 2006; Miller, 2011). In a study of the comorbidity of APD, LI and Reading Disability, Sharma, Purdy and Kelly (2009) found that the majority of participants had a "combination of difficulties than a pure diagnosis of a single disorder" (p. 713). The researchers note the challenges in

diagnosing the three disabilities due to a lack of consensus among professionals on which assessments to use and the fact that the available assessments cannot distinguish between these three disabilities (Sharma et al., 2009). Children with LI who also qualified for an APD diagnosis had difficulty in auditory processing tasks related to temporal processing (Sharma et al., 2009). The same temporal processing was found by Fostik, Bar-El and Ram-Tsur (2012) in dyslexic readers. However, an auditory processing basis for dyslexia is debated among researchers (Miller, 2011).

WHAT IS THE RELATIONSHIP BETWEEN AUDITORY PROCESSING AND READING?

Understanding auditory processing and its related terms was a pivotal point in this research. Understanding the different components of auditory processing helped indicate specific ways that auditory processing may break down and how these breakdowns can affect reading skills. The challenges my students were facing manifested as deficits in a variety of literacy skills that rely on intact auditory processing. The skills themselves are considered cognitive communicative and/or language functions (American Speech-Language-Hearing Association, 2005). Through synthesis of the challenges I observed in my students, I have consolidated these problem areas into five categories. Below, I will analyze the relationship between these cognitive communicative skills and auditory processing. The areas I will explore are: letter names and sounds; phonological awareness, decoding, sight words and fluent reading.

While I will discuss several areas of auditory processing and how they relate to reading challenges, it is important to note that auditory attention is the common link between auditory processing and all five areas. This defines a child's ability to "tune into auditory input" (Riggs, n.d., para. 4). Auditory attention affects reading specifically since reading deals with a symbolic way of representing sound. However, in order for children to learn the building blocks of reading or to learn any of the orally presented information in school they need to be able to attend to auditory information. Children with weaknesses in auditory attention may experience overall learning challenges.

Michael was a bright enthusiastic Kindergartener I worked with my first year teaching. Michael had an intense love for animals and could list extensive details about a variety of different ones. Upon having a conversation with Michael you would never guess the seriousness of his learning challenges. By the middle of Kindergarten, Michael had failed to learn a single letter name or sound even after receiving intervention. Michael could visually recognize a few letters when asked to find them, and had developed a whole host of compensatory strategies to help sustain himself in the classroom. However, he was quite aware of his challenges and had a strong desire and motivation to learn to read.

Michael's challenges seemed be related to the associative nature of learning symbols that represent sounds. Children like Michael who experience difficulty remembering letter names and letter sounds, may struggle with auditory association, and have weaknesses in auditory memory. Auditory association "is the attachment of meaning [to sound]. It requires the listener to identify an acoustic signal and associate it with its source or to label a linguistic or non-linguistic sound or experience" (Florida Department of Education, 2001, p. 3). Auditory association is an integral part of auditory memory (Florida Department of Education, 2001).

According to Riggs (n.d.), auditory memory is the "ability to store and recall auditory information" (para. 4.). Reading relies on the ability to integrate visual and auditory processes as well as the use of a variety of language and cognitive functions (Wolf, 2007). Learning the alphabetic symbols of one's written language is a prime example of this task. The new reader must learn to match written symbols with auditory

cues that represent sound units of spoken language. Children with weaknesses in auditory memory will find this process difficult.

Another factor related to learning letter sounds is auditory discrimination, which is defined as "the ability to distinguish between different sounds or words" (Riggs, n.d., para. 4). Children who have difficulty associating letters with sounds that sound similar such as b and p; th, v and f.; and vowels a, e, i, o, u may not be confusing the letters as it may appear, but instead may be unable to perceive the differences in these sounds.

An additional auditory processing skill affecting auditory discrimination is auditory tonal processing. Defined as "the correct processing of sounds or tones," children having difficulty differentiating between sounds may lack the ability to perceive differences in the pitch or intensity of the sound (Riggs, n.d., para. 4). For example, the sounds for the letters b and p are quite similar, however the pitch of the sound p is much higher than b, and the intensity of the p sound is much greater than the b sound. A child who has difficulty perceiving these differences will have difficulty matching letters to their correct sounds.

Finally, learning letter names and sounds requires auditory attention, which is defined as a child's ability to "tune into auditory input" (Riggs, n.d., para. 4). Children learning letter names and sounds not only need to attend to the auditory information of the letter name and its sound, but to any auditory information the teacher may present as a way of teaching these areas.

PHONOLOGICAL AND PHONEMIC AWARENESS

Katherine is a current student with whom I started working during my first year teaching. Katherine has a speech and language disability, which affects her progress in

reading. When Katherine first started the process of learning to read she had difficulty detecting and generating rhymes, segmenting and blending phonemes, deleting and substituting phonemes.

Sarah, another student I taught my first year had immense difficulty blending individual units of sounds independently and when presented with oral phonemes. When Sarah attempted to blend sounds, the result were words that sounded quite different from the sounds she was blending. Blending sounds left Sarah extremely frustrated and anxious about reading, and left her teachers feeling very perplexed.

Katherine and Sarah both demonstrate challenges in the area of phonological awareness. According to Schuele and Boudreau (2008) "phonological awareness is the ability to attend to and make judgments about the general sound structures of language" (p.6). Phonological awareness skills include the ability to divide words into syllables, identify and generate rhymes and matching words with the same initial sounds. Katherine's difficulty rhyming, demonstrates weak phonological awareness skills.

More complex aspects of phonological awareness that require "the ability to isolate and manipulate individual sounds or phonemes" are referred to as phonemic awareness (Schuele & Boudreau, 2008, p. 6). Sarah's difficulty blending sounds and Katherine's difficulty segmenting, blending, deleting and substituting phonemes represent weak phonemic awareness skills. Schuele and Boudreau (2008) note that poor phonemic awareness has been linked to poor reading achievement by several researchers (Blachman, 1997; Torgesen, Wagner, & Rashotte, 1994; Stanovich, 1986).

Phonological awareness skills require a range of auditory processing skills. For16 example, phonemic awareness skills require extensive levels of auditory attention. Children who have difficulty manipulating auditory information (i.e. segmenting, blending, phoneme deletion or substitution) may also have weaknesses in auditory memory. For example, in order to substitute the /m/ in man for a /p/ to create the word pan, the reader needs to hold onto the original cluster of sounds, determine the rime without the onset and then blend the sounds together using a new onset. These skills require the ability to hold on to auditory information long enough to manipulate it in some way, a task that would prove very difficult for a child with a weak auditory memory.

Furthermore, auditory synthesis and auditory analysis are two auditory processing skills necessary for segmenting and blending. According to the Florida Department of Education (2001, p.3) auditory synthesis is "the ability to synthesize (i.e., merge or blend) isolated phonemes into words." The phonological awareness skill blending relies on auditory synthesis. In addition, segmenting requires the auditory processing skill auditory analysis, which is the ability to "identify phonemes or morphemes embedded in words (Florida Department of Education, 2001, p. 3). Children like Katherine and Sarah who experience difficulties with segmenting and/or blending phonemes may have weaknesses in the areas of auditory analysis and/or synthesis.

Another auditory processing weakness that has received considerable attention in its relation to dyslexia is called temporal processing. An analysis of the research on this topic by Fostik, Bar-El and Ram-Tsur (2012) reports several studies that examine this relationship (Ben-Artzi, Fostick & Babkoff, 2005; Chung, McBride-Chang, Wong,

Cheung, Penney & Ho, 2008; Schaffler, Sonntag, Hartnegg, & Fischer, 2004; Tallal, 1980; Tallal & Piercy, 1973a, 1973b; Reed, 1989; Van Ingelghem, van Wieringen, Wouters, Vandenbussche, Onghena & Ghesquiere). Tallal (1980) was the first to propose that the phonological weaknesses demonstrated by children with dyslexia were caused by difficulties in rapidly processing auditory stimuli.

According to Shinn (2003) auditory temporal processing is "the perception of sound or of the alteration of sound within a restricted or defined time domain" (p. 52). Temporal processing relates to the rate of processing and also includes sequential processing- how many pieces of information one can listen to (receive), store, recall, and utilize (Riggs, n.d.; Florida Department of Education, 2001; Shinn, 2003). The exact nature of the causal relation between temporal processing and dyslexia is debated within the research (Share, Jorm, Maclean & Matthews, 2002; Marshall, Snowling & Bailey, 2001).

Phonological and phonemic awareness skills such as rhyming, determining initial sounds, segmenting, blending, phoneme deletion and substitution require that a child can accurately sequence sounds. In addition, blending in particular requires that the rate of processing between sounds is rapid enough for the child to detect a familiar word. If a child experiences a delay in processing individual sounds, he or she may have difficulty blending the units of sound together to form a comprehensible word. Both Sarah and Katherine demonstrated difficulties sequencing and rapidly processing sounds when blending.

DECODING

Andrew is a current student who struggles in reading. When he approaches an unfamiliar word he guesses at the word, using context or the first letter sound, causing his reading to be very inaccurate. The process of decoding is extremely difficult for Andrew, and thus he avoids it as much as possible. When Andrew attempts to decode, he has difficulty remembering letter sounds and correctly sequencing and blending sounds. In some cases, by the time he segments a whole word, he forgets the sounds in the beginning of the word and ends up only blending the end of the word. In other cases he accurately segments and blends the phonemes, but cannot detect a familiar word or blends the sounds together adding in sounds that are not present (for example /b/a/ck/ becomes black).

Since children's phonemic awareness is critical for learning to decode, many of the auditory processing skills involved in phonological awareness are also relevant for decoding (Juel as cited in Wolf, 2008). For example, the process of decoding relies heavily on auditory memory and auditory association. First the reader needs to retrieve and produce each of the sounds for the written letters, then remember the sounds he produces in sequence and then once the sounds are blended together, the reader needs to match the blended word to a familiar word in memory. The National Reading Panel (2000) explains the auditory memory challenge involved in decoding stating, "by the time the student gets to the last sound, he may have forgotten the first one" (Gunning, 2010, p. 225).

Decoding also requires the same, auditory attention for detecting phonemes, temporal and sequential processing and auditory synthesis and analysis skills for

segmenting and blending, that are necessary to develop phonological awareness. Research indicates that a child's ability to segment and blend are the strongest predictor of decoding skills (Schuele & Boudreau, 2008). It is likely that Andrew may be experiencing weaknesses in several of these areas, which contribute to his difficulty decoding.

SIGHT WORDS

Jessica is a student with a speech and language impairment whom I taught my first year. Jessica struggled to learn letter names and sounds, and had tremendous difficulty retaining new sight words. Even after extensive intervention, Jessica had only managed to learn about 10 sight words the whole school year, many of which she forgot over the summer. While it was most common for Jessica to forget sight words, in some cases she would substitute one word for another or forget a sight word from one page of a book to the next.

Learning sight words requires readers to match visual patterns to auditory units in the form of a word. The right hemisphere of the brain is responsible for visual processing and visual storage, whereas the left hemisphere processes and stores auditory information (Wolf, 2007). Children, who have difficulty retrieving auditory information from the left hemisphere to integrate it with the visual information from the right hemisphere, may have weaknesses in long-term auditory memory. These children have difficulty storing and retrieving auditory information even when it is practiced repeatedly.

Weaknesses in auditory memory and auditory association may also lead to weak storage of auditory information making it more common for children to mix up sight

words, substituting one word for another. In addition, this weakness may also contribute to a child's inability to remember a sight word from one page to the next (short-term auditory memory deficit). Children with auditory memory weaknesses may have difficulty learning and recalling new words like Jessica.

FLUENCY

James is a current student with a speech and language impairment whom I began teaching my first year. Though James is one of the hardest working students I have ever met, his reading is slow and labored. James has difficulty remembering letter sounds making his decoding inaccurate, and struggles to remember sights words significantly hindering his ability to read fluently.

As the example of James indicates, children who experience difficulties in the four areas previously discussed: learning letter names and sounds, phonological awareness, decoding and sight words, will have difficulty becoming fluent readers. Therefore fluent reading requires simultaneous functioning of all auditory processing skills used in these four areas including: auditory attention, auditory memory, auditory discrimination, auditory tonal processing, auditory association, auditory sequential processing, auditory temporal processing, auditory synthesis and auditory analysis. A deficit in any of these areas could impact a child's ability to read fluently. The sheer number of auditory processing skills required for fluent reading exemplify why the cause of reading difficulties is considered extremely complex (Gunning, 2010).

Finally it is important to note that while auditory processing is a vital aspect of reading development, it works in combination with several other systems. These systems

include a variety of language skills, visual processing, visual memory and executive functioning (attention, initiation, organization, working memory, mental flexibility and problem solving) (Wolf, 2007). Weaknesses in any of these areas would also contribute to reading difficulties. Therefore, if teachers work to strengthen weaknesses in auditory processing and their students are still struggling in reading, they begin to examine these other areas.

WHAT RESOURCES CAN TEACHERS USE TO HELP CHILDREN WITH AUDITORY PROCESSING WEAKNESSES IMPROVE IN READING?

The following section will provide resources that educators can use to support students with auditory processing weaknesses. These resources are categorized into "Programs", "Additional Resources" and "Phonics Games" which I have either used with my students, or intend on using in the future. In addition, because the learning environment is an important factor in how children learn, this section will also suggest ways to modify the classroom environment to better support children with auditory processing weaknesses.

According to Pamela Gillet (1993) children with auditory deficits benefit from reading programs that incorporate visual and/or kinesthetic learning rather than auditory or phonics methods. Gillet (1993) also recommends teaching sight words, using theme-based reading activities, Orton-Gillingham based programs and providing "intensive remedial training in all auditory areas" (Gillet, 1993, p. 96). Theme-based reading activities are activities that focus on a specific topic. The topic encompasses related vocabulary. For example, a literacy lesson that focuses on the subject of family would include vocabulary such as mother, father, sister, brother etc. Orton Gillingham is a multisensory synthetic phonics approach proven effective for children with reading difficulties (Gunning, 2010). In addition to recommendations stated above, Gillet's (1993) book "Auditory Processes" provides hundreds of suggested activities for building auditory processing skills.

Furthermore, Gillet (1993) recommends that instruction be individualized and provide "meaningful repetition" (Gillet, 1993, p. 99). Meaningful repetition involves

interacting with material in engaging ways that build understanding and support memory. She also recommends approaches that use the same words to read, spell and write because this helps connect the visual system, memory, perception and language (Gillet, 1993).

Beyond individualized intervention, there is also research that suggests that music education supports auditory processing skills (Degé, Wehrum, Stark & Schwarzer, 2011). In a two year study of 10 year-olds receiving music training Degé and colleagues (2011) found that this training significantly improved children's auditory memory. Therefore, teachers working to improve children's auditory processing skills may want to consider incorporating music into their practice. Gillet (1993) suggests several musical activities for auditory processing training in her book. For example, in one activity that uses musical instruments to help children practice discriminating sounds, the student listens as the teacher plays each instrument. Then the teacher plays an instrument while the child closes his eyes. When the child opens his eyes he must determine which instrument created the sound (Gillet, 1993, p. 22, activity 1).

PROGRAMS

Sounds in Motion (SIM)

SIM (Santore, 2010) is a 15 week phonemic awareness program designed by Speech Pathologist Frances Santore, M.A. CCC-SLP, to address auditory processing, early literacy and articulation skills through movement. The movements are designed to match the pitch, duration, tension, placement of the articulators in space and intensity of

the sound being produced. The motions are based on the VerbalTonal Method created by Croatian linguist and speech scientist, Petar Guberina (Santore, 2013).

How does SIM support auditory processing skills needed for reading?

SIM helps children learn letter sounds. Its use of kinesthetics to teach letter sounds helps stimulate auditory memory. Its focus on sound and sound manipulation through oral language helps promote auditory attention. In addition, SIM teaches phonemic awareness skills by having children segment and blend using the motions. The carefully designed motions help children discriminate between similar sounding phonemes. The SIM curriculum also includes listening activities that require students to listen to stories and identify sounds or rhymes they hear. These activities support auditory attention, auditory memory and auditory discrimination.

I have found SIM helpful in teaching letter sounds, phonemic awareness skills such as phoneme perception, segmenting and blending, rhyming, and phoneme discrimination, building decoding skills and supporting auditory memory. It was especially beneficial for my students who were having difficulty discriminating between vowel sounds. For children who were having difficulty with auditory association, I made a visual chart with the written vowel symbol next to photographs of my students doing the vowel motions. After a while students were able to associate the written symbol with the sound and its motion without this visual aid. In addition, as children became proficient in orally segmenting and blending using the motions, they were able to use this procedure when decoding written words.

Systematic Instruction in Phonological Awareness, Phonics and Sight Words

Systematic Instruction in Phonological Awareness, Phonics and Sight Words (SIPPS)® is a phonemic awareness, phonics and sight word intervention program created by the Developmental Studies Center (DSC). The program has three levels (Beginner, Extension, Challenge) and offers a placement test for determining where to begin students. Each lesson follows a specific sequence which incorporates oral blending and segmenting, letter sound identification, decoding, sight word practice, reading and spelling.

How does SIPPS support auditory processing skills needed for reading?

The oral blending and segmenting component helps students develop phonemic awareness skills. The sound cards include interesting visuals and key phrases that support auditory memory by triggering memory of the sound the letter makes. For example, the letter s has a picture of hissing snake. Students repeat "s -hissing snake- /ssss/. The key phrase is meant to help students remember the sound a hissing snake makes which replicates the sound of the letter s. The sight word component builds students auditory association and memory using repetitive practice through flash cards and short stories. Students also receive repetitive practice in decoding by decoding in isolation and in a short story.

The short stories are also theme-based, which Gillet (1993) recommends as an effective reading approach for children with auditory processing weaknesses. The books include themes such as families, the park and the zoo. The program's reading, writing

and spelling activities use the same words, which supports Gillet's (1993) recommendation for connecting different sensory processes.

I used both the beginner and extension levels with my students. The beginner level was incredibly effective in improving my student's phonemic awareness, decoding and sight word skills. Students enjoyed the short stories and felt successful reading them. The slow and systematic pace of the program helped my early readers quickly progress.

Since many of my students already had been exposed to Fundations® (Wilson Language Training Corporation, 2012), I did not introduce the SIPPS sound cards. These students were familiar with Fundations®' "key pictures" which matched their initial sound with the sound of the letter, a different approach than SIPPS. Instead during the sound review I would teach and have students practice the SIM motion for the letters presented that day. Once students began decoding consonant-vowel-consonant (cvc) words, I discontinued SIPPS and began using more natural guided reading texts. I also used SIM to teach students long vowels since the beginning level of SIPPS only includes short vowels.

I also tried the SIPPS Extension Level for students who placed into this level. Students benefited from the decoding and sight word practice, but the Extension Level texts were too long for my students. Most of them struggled through the texts and became quickly bored by the program. I discontinued it after a month.

The Nessy Reading Program (Nessy™)

Nessy™ is an Orton-Gillingham computer-based reading program. Students begin the game-like program with an assessment test that sets learning targets to meet

while playing. Students then cycle through different levels targeting different phonics skills through a variety of games. The games include tasks such as blending words, answering reading comprehension questions, rhyming, segmenting phonemes, spelling and building sentences. When students have successfully completed all the games at a level they wake up a sleeping animal and move to a new island to target a new skill.

How does Nessy™ support auditory processing skills needed for reading?

Nessy™ builds phonemic awareness skills through rhyming, segmenting and blending activities. It teaches children sight words through mnemonics, which support auditory memory. For example, children are taught to remember the "bus" part of the word "busy" through the mnemonic "busy on the bus." The game-like nature of the program is engaging and motivating for students, which promotes auditory attention by requiring students to tune into auditory information and follow direction in order to succeed at each game. A variety of games at each level give students repetitive practice in decoding and recognizing sight words.

A variety of the Nessy™ games also build auditory memory and auditory sequential processing skills by presenting students with auditory information to remember and manipulate. For example, a sentence building game provides students with an auditory and visual sentence, which they need put back in the correct order. Students need to remember the auditory sequence in order to complete this task.

I used Nessy™ with a small phonics group of second graders for two months. My students really enjoyed this program initially, and I saw gains in all of their decoding and reading skills. For many of my students who have difficulty focusing, this was the first

time I saw them deeply engaged and invested in phonics work. However, as students moved onto new levels with unfamiliar phonics patterns, they required more and more support, and became increasingly frustrated. The program also requires you to repeat a game until you have answered every question correctly, which sent many of my students into a meltdown when they got a question incorrect. I discontinued this program with that small group, but I continue to use it as an intervention for individual students.

Right Brain Phonics; Right Brain Sight Word Technique

The Right Brain Phonics technique is designed to compensate for weak auditory processing skills. Special Educator Diane Craft (2012) has created a phonics and sight word program based on this technique, but I have not yet tried her program. This technique is based on the premise that children with weaknesses in the auditory or left hemisphere of the brain benefit from using the more visually oriented part of their brain, the right hemisphere. In this technique, meaningful visuals are embedded within letters or sight words to help trigger the letter sound or word. For example, the letter "a" may have picture of an apple superimposed on top of it.

How do Right Brain Phonics and Right Brain Sight Word technique support auditory processing skills needed for reading?

The Right Brain Phonics and Sight Word technique helps support auditory association and auditory memory by utilizing the stronger visual pathway as a means for triggering auditory information. It has the potential to support decoding and fluency by helping children quickly retrieve letter sounds, a necessary factor for decoding fluently

and accurately. While I have not used Craft's (2012) Right Brain programs, my colleague is using this technique with Michael (the student discussed above with auditory association challenges). My colleague and Michael work together to create meaningful associations between letters and their sounds and then draw these images within each letter. Michael practices naming and producing the sound for each of these letters several times before repeating this procedure for letters without images. In the few weeks since beginning this technique, Michael has vastly decreased the amount of time it takes him to retrieve letter sounds.

Fundations® Fluency Kit

The Fundations® Fluency Kit (Wilson Language Training Corporation, 2012) is a supplemental program to the Fundations® phonics program (Wilson Language Training Corporation, 2012). It is designed to help children build automatic and accurate decoding skills. The kit comes with automaticity cards that include sounds, decodable words, nonsense words and trick words. It also contains fluency cards that include phrases and short stories. Students work on one unit at a time practicing the cards and then reading them while being timed. The highest number of sounds or words correct is recorded on a recording sheet.

How does the Fundations® Fluency Kit support auditory processing skills needed for reading?

The Fundations® Fluency Kit helps build auditory memory and association skills needed to rapidly recall letter sounds. It also provides students with repetitive practice in

decoding which supports automaticity and fluency. I just began using this program with James, my student who struggles to read fluently. I have seen that a few weeks of the program has helped strengthen his ability to decode more fluently and accurately.

Earobics®

Earobics® is a computer-based reading program (Houghton Mifflin Harcourt Publishing Company, 2009) that builds phonemic awareness, phonics, comprehension, vocabulary, fluency and writing skills. It uses adaptive technology to adjust to the level of each student, teaches phonics through manipulatives and music, and builds fluency through multi-media resources (Earobics®, 2007). I have not used Earobics®, but it was highly recommended by my school's speech pathologist as an effective literacy intervention for children with auditory processing weaknesses.

How does Earobics® support auditory processing skills needed for reading?

Though I cannot speak from experience about how Earobics® supports auditory processing skills, a study by Miller, Uhring, Brown, Kowalski, Roberts and Schaefer (2005) provided some insight. For example, a game called "Calling All Engines" requires students to follow directions (Miller et al., 2005). This game builds auditory attention, auditory memory and auditory sequential processing skills (Miller et al., 2005). Other games require students to "count, segment, and manipulate sounds and words," "identify a target phoneme or syllable among a sequence of distractors," "blend phonemes and syllables," and "identify a phoneme or syllable that matches a target" (Miller et al., 2005, p. 96). These games build auditory attention, auditory memory,

auditory sequential processing, auditory discrimination, auditory synthesis and auditory analysis skills.

ADDITIONAL RESOURCES

Phonological Awareness Intervention; Beyond the Basics

The article Phonological Awareness Intervention; Beyond the Basics (Schuele & Boudreau, 2008), provides a systematic list of phonological awareness skills to teach. It also includes information on the duration and intensity for implementing the intervention, ways to scaffold skills, models for presenting tasks and ways to respond to students' errors. It can be used by teachers to design and implement a phonemic awareness program or to target specific phonemic awareness skills.

Phonemic Awareness in Young Children

Phonemic Awareness in Young Children (Adams, 1998) describes a phonemic awareness curriculum to be implemented through 15-20 minute daily activities. The different components of the curriculum include listening games, rhyming, words and sentences, awareness of syllables, initial and final sounds, phonemes, letters and spellings and an assessment.

SightWords.com

The website (http://www.sightwords.com, 2015), based on the research of Barbara Wilson (Wilson Reading); Samuel Orton, MD; Anna Gillingham (Orton-Gillingham); Grace Fernald; Beth Slingerland (multi-sensory approach); C. Wilson Anderson (International Dyslexia Association); and Siegfried Engelmann (Direct Instruction), provides a routine for teaching sight words, sight word lists, printable flash cards and game ideas and templates. This multisensory approach to teaching sight words helps support auditory memory and auditory association. I have used several of the resources from this website to successfully help my students learn new sight words.

PHONICS GAMES

The following are a list of games I use with my students to provide them with repeated practice in decoding and/or sight words.

The Decoding Board Game

For the Decoding (or sight word) Board Game, construct a laminated blank game board (I have a jungle board that I downloaded from my school's Reading A-Z account (Learning A-Z, n.d.), game pieces (I use teddy bear manipulatives from my math materials), a dice and a stack of flash cards (either decodable words with patterns my students are working on or sight words). Students roll the dice, flip over a flash card and read the word. If they read the word correctly, they can move their game piece. My

students love this game. It is easy to prepare and can be reused over and over again to practice different phonics patterns.

Pirate Attack

I found Pirate Attack (Rayburn, n.d.) on Reading Resource at http://www.readingresource.net/support-files/pirateattack.pdf. Print and cut out the pirate and treasure images as well as the pirate ships. Each student gets a pirate ship. The teacher hides the pirate and treasure images underneath decodable words or sight words. When its their turn, the student chooses a word to read and then lifts up the word to reveal either a pirate or treasure. If they find treasure they get to take it and put it on their pirate ship. If they find a pirate they have to leave it on the table. My students especially enjoy the anticipation of revealing the images when we play this game.

4 in a Row

For this game create a 5-box by 5-box grid on the computer or on chart paper. Give every box on the grid a number from one to six; each number should be repeated at least twice. Then add a decodable word or sight word to each box. Students choose a marker (we use math manipulatives) then roll a dice. They find the box with the number they rolled and read the word. If they read the word correctly they place their marker on the box. The student who is first to get four markers in a row wins.

I Have. Who Has?

In this game, children use cards (I have downloaded some off of teacherspayteachers.com, but you can also make your own) that say, "I have___ who has____?" On the first card write a decodable word in each blank. On the second card write the word from the "who has" blank on the "I have" blank and new word on the "who has" line. Continue this process so that each card signals the next card linking them all together. For example, I have dog, who has cat; I have cat, who has hop; I have hop who has dig; I have dig, who has dog? Students need to listen to each other so they know when their card has been called. Make sure to write "the first card" on the first card and link the "who has" on the last card to the "I have" on the first card so that the game can repeat a few times.

Snakes and Ladders

An online version of Snakes and Ladders (Bruce, n.d.) can be downloaded at http://www.adrianbruce.com/reading/snakes. Download and print the Snakes and Ladders game template from the website. Write decodable words or sight words in each blank space. Place game pieces at start. Have students roll a dice and move horizontally across the game board. When they land on a word they should read it. Students can climb up the ladders and slide down the snake to make their way to the top of the board. I have my students repeat this game multiple times to expose them to all the words on the game board.

HOW CAN TEACHERS MODIFY THE CLASSROOM ENVIRONMENT TO SUPPORT THE LEARNING OF CHILDREN WITH AUDITORY PROCESSING WEAKNESSES?

The following list of environmental modifications comes from the Florida Department of Education (2001). These modifications help support auditory attention, an important factor in the learning process.

- Provide preferential seating
- Create an independent work area
- Use an FM system to amplify the teacher's voice
- Work in an enclosed space
- Use carpets to absorb ambient sound
- Provide small group instruction when possible

Additionally the following list from the Minnesota Department of Children, Families & Learning (2003) provides compensatory strategies for supporting children with auditory processing weaknesses.

- Use visual aids and write instructions
- Gain the child's attention before beginning a lesson or providing instructions
- Check for comprehension by having the child repeat directions
- Rephrase or restate information if the child does not understand
- Pre-teach concepts, ideas or vocabulary before a lesson
- Provide students with short breaks

CONCLUSION

My year of research on the relationship of auditory processing and reading helped me develop an understanding of the definition of auditory processing and analyze how weaknesses in auditory processing skills impact reading development. I came to realize, that just as reading challenges are complex, so too are auditory processing weaknesses. From this work, I learned the importance of being open and flexible when designing interventions that build the auditory processing skills of readers. No one program or approach will be right for all children. In fact, some children will require multiple programs and approaches to build the skills they need to be successful readers. Teachers with wide tool-kits will be able to mix-and-match programs and approaches to find the right match for their students.

This research and the interventions I found and implemented with my students helped me to develop greater skill in supporting students with auditory processing weaknesses. It is my hope that other teachers can use this research to widen their tool-kits to help support their students as well.

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